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REVIEWS

“The Skeleton of *Ornithodesmus latidens*.” By R. W. HOOLEY.
In the *Quarterly Journal of the Geological Society*, LXIX
(1913), 272-422; pls. XXVI-XL.

The present paper is of much interest and of importance in any discussion as to the relationships and structure of the pterodactyls. By diligent collecting Mr. Hooley has brought together a very considerable portion of the skeleton of a remarkable form hitherto known only doubtfully from fragments. *Ornithodesmus* is a pterodactyl of considerable size, more primitive in some respects than the American forms, but with certain peculiarities all its own. Its narial and antorbital vacuities are of enormous size; it has teeth in the front part of the jaws; a large keel on the sternum; a notarium and vertebral articulation of the scapula; doubtless a short tail; and no pubic opening.¹

The femur Mr. Hooley describes as different from that of *Pteranodon* or *Nyctosaurus* in the divergence of the neck, but really there is no essential difference, the articular surface in all being at the extreme top, and its significance has already been discussed by the writer. Mr. Hooley believes that the wing metacarpal was shorter than the forearm; but that remains to be proved.

The pterodactyls offer a fertile field for speculation, and the author has availed himself of the opportunity presented by *Ornithodesmus* to propose a number of hypotheses as to the structure and habits of these strange reptiles, some of which are ingenuous, but the most of which seem doubtful to the present writer. He proposes an entirely new hypothesis as to the structure of the sternum, but one which is quite impossible of demonstration, if it be true, until the terrestrial ancestors of the pterosaurs have been discovered in Triassic rocks. He believes that the so-called manubrium, and the keel, whether large, as in *Ornithodesmus*, or small, as in *Pteranodon*, are really composed of the inter-

¹While at Munich recently Dr. Stromer and the writer convinced themselves thoroughly of the presence of a true obturator foramen below the acetabulum, occupying its usual position in the early reptiles. Probably thorough search will reveal its presence in some form in all pterodactyls, definitely proving the fusion of pubis and ischium.

clavicle, to which the articulation of the coracoids has migrated and which is indistinguishably fused with the sternum proper.

The sternum is a comparatively late development in reptiles. In the primitive reptiles there was none, not even a cartilaginous one. The coracoids in all primitive reptiles met or nearly met in the middle line, underlain in their whole extent by the posterior prolongation of the interclavicle. Back of the coracoids, occupying the interval between their divergent hind borders and reaching to the pelvis, the under side was sheathed by ventral ribs in the majority of forms, leaving no space for even the smallest cartilaginous sternum. This condition has been found so often and in such perfect preservation among American Permo-Carboniferous reptiles that there can be no doubt of the entire absence of the sternum in all forms. Just what was the origin of the sternum, and the cause of its appearance, are of course yet unproven, but it seems to the writer extremely probable that the sternum is nothing more nor less than modified sternal ossifications in the parenchymatous tissue, of the same nature as the more posterior ribs and originally a part of the same series.

Evidence now seems conclusive that the plesiosaurs and ichthyosaurs are of very primitive origin, doubtless descended from terrestrial reptiles which had not yet acquired a sternum, and in which the coracoids met in the median line.

That the coracoids of the pterodactyls should have formed an articulation on the interclavicle in the absence of clavicles and the presence of an ossified or cartilaginous sternum is an improbable theory without any evidence that the writer can see to sustain it.

Mr. Hooley reaches some interesting conclusions as to the mechanics of the arm and forearm in *Ornithodesmus*, but which are not borne out by the American specimens of pterodactyls. He asserts that the radius, so far from its lying parallel with the ulna or in a pronated position, had acquired an over-supinated position, with its distal extremity on the dorsal side of the ulna. He also asserts that there was great freedom of movement in the carpus, not only dorsoventrally, but in an antero-posterior direction. With the arm extended and the elbow backward and the thumb in front, the humerus must necessarily occupy an oblique position or the radius is slightly pronated. With the radius crossing back of the ulna to the dorsal side, the palm of the hand would be turned forward. It is true that the wing metacarpal and the phalanges in their function of supporting the patagium have acquired an anomalous position in that the articulations have become antero-posterior instead

of dorsoventral; and doubtless this position has been acquired by a rotation on the carpus. But, to oversupinate the hand would turn the articulations anterior; and it seems very improbable. It may be added that the peculiar spiral position of the "deltoid" crest is a characteristic of all primitive reptiles.

As to the extreme freedom of movement in the carpus asserted by Mr. Hooley, one needs but to consult Dr. Eaton's excellent photographs of *Pteranodon* to be convinced of its impossibility, in that genus at least. That there was a considerable antero-posterior movement between the forearm and the wrist is not improbable, but that there was much movement dorsoventrally seems impossible.

As regards the classification of the Pterosauria, he makes some startling changes. He believes that most of the characters hitherto used, such as the shortening of the tail, the lengthening of the wing metacarpal, the development of a notarium and vertebral connection of the scapula, are all homoplastic characters, and the previous classification consequently an artificial one. He unites *Rhamphorhynchus* with *Pteranodon* in the Rhamphorhynchoidea; *Pterodactylus* he locates almost alone in the Pterodactyloidea; while for *Ornithodesmus*, *Dimorphodon*, etc., he makes a new sub-order, the Scaphognathoidea. And the grounds for this classification he finds almost exclusively in the degree of ossification of the facial part of the skull! Certainly there is more difference between *Rhamphorhynchus* and *Pteranodon* than between the latter and *Pterodactylus*, necessitating the resuscitation of Marsh's Pteranodontia. And then the next proposition doubtless will be to erect *Dimorphodon* into a sub-order all its own, till finally we shall have every genus a family and every family a sub-order! The writer disagrees with the proposed classification *in toto*.

S. W. WILLISTON

Untersuchungen über die Bildungsverhältnisse der ozeanischen Salzablagerungen, in besondere des Stassfurter Salzlagere. By J. H. VAN'T HOFF and ASSOCIATES. Leipzig: Akademische Verlagsgesellschaft m. b. H., 1912. Pp. xix+374, figs. 39, pls. 8.

The now classic work of van't Hoff and his associates on the crystallization of salts from sea water first appeared in the *Sitzungsberichte der Kgl. Preus. Akad. der Wissenschaften*, and later, in two volumes published by Vieweg u. Sohn. Additions to the earlier work appeared